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VERTEBRATE PREY OF THE BARN OWL (*TYTO ALBA*) IN SUBTROPICAL WETLANDS OF NORTHEASTERN ARGENTINA AND EASTERN PARAGUAY

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KEY WORDS: *Barn Owl*; Tyto alba; *Iberá-Ñeembucú Wetlands*; *diet*; *prey biomass*; *Argentina*; *Paraguay*.

In South America, the diet of the Barn Owl (*Tyto alba*) has been studied primarily in temperate and arid regions of Argentina and Chile (Jaksic 1996, Pardiñas and Cirignoli 2002). In the vast tropical and subtropical-humid areas this owl is poorly known (e.g., Motta-Junior 1996, Bellocq 2000, Vargas et al. 2002). Here, we describe the vertebrate prey consumed by Barn Owls in the subtropical wetlands of the Iberá-Ñeembucú system (Argentina and Paraguay).

STUDY AREA

The Esteros del Iberá (Corrientes Province, Argentina) is a Ramsar site of 13 000 km^2, making it one of the largest wetlands in South America. The Esteros del Ñeembucú (Ñeembucú Department, Paraguay), with ca. 4000 km^2, cover an extensive region on the left bank of Paraguay River. Both wetlands (Fig. 1A) display a complex mosaic of marshes, "*embalsados*" (massive carpet of floating vegetation, mostly composed of accumulated, dead, and decomposing plant material). These wetlands are intermixed with extensive palms of *Copernicia alba* and gallery forest, and have remained mostly unmodified by human activities (Carnevali 1994). The climate is humid subtropical (according to Köppen's [1931] classification scheme), with a mean annual temperature of 23ºC and mean annual precipitation of nearly 1350 mm (Carnevali 1994).

METHODS

The owl-pellet samples ($N = 14$) were collected during the breeding seasons of 2001–02 and 2002–03 (September–December) from human buildings at 11 localities in the Iberá-Ñeembucú wetlands (Fig. 1A). Because of the humid environment, pellets rapidly disintegrated (<1 mo). Therefore, the precise number of pellets included was undetermined. We also included two samples of pellet debris (localities of Ensenadita and Desaguadero) from the west border of Iberá, at a site previously studied by Massoia et al. (1988, 1990).

Only vertebrates were considered in this study; invertebrates (mainly insects) were also present in some sam-

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Table 1. Vertebrate prey items found in pellets of the Barn Owl from Iberá-Ñeembucú wetlands (Argentina and Paraguay). Numbers in parentheses refer to Figure 1. Percent biomass (%B) are given in grams (g) for samples with $N > 50$.

		Pilar (1)		Ensenadita (2)		Desaguadero (3)		El Sombrero (4)		El Pontón (5)		Ea. Cerro Pytá (6)		Ea. San Ignacio (7)	
	Mass	*N*	%B	*N*	%B	*N*	%B	*N*	%B	*N*	%B	*N*	%B	*N*	%B
Rodents															
Akodon azarae	28	15	4.8	—	—	30	1.9	14	0.7	6	0.4	6	1.2	—	—
Akodon montensis	39	—	—	—	—	—	—	5	0.4	—	—	—	—	—	—
Calomys cf. *C. callosus*	31	—	—	1	1.1	41	1.8	24	1.3	34	2.7	2	0.5	—	—
Cavia aperea	525	—	—	—	—	13	9.6	1	0.9	2	2.7	—	—	3	8.2
Holochilus sp.	150	44	75.9	6	31.1	270	56.9	313	84.3	197	75.8	68	74.3	113	88.0
Necromys temchuki	47	—	—	8	13.0	69	4.6	32	2.7	49	5.9	—	—	—	—
Oligoryzomys cf. *O. flavescens*	22	—	—	—	—	—	—	3	0.1	8	0.5	—	—	—	—
Oligoryzomys cf. *O. flavescens*	17	20	3.9	6	3.5	101	2.4	28	0.9	41	1.8	85	10.5	6	0.5
Oxymycterus rufus	76	—	—	3	7.9	33	3.5	20	2.7	20	3.9	3	1.7	1	0.4
Rattus sp.	160	3	5.5	—	—	3	0.7	—	—	—	—	—	—	—	—
Scapteromys aquaticus	112	3	3.9	4	15.5	64	10.1	25	5.0	18	5.2	3	2.5	3	1.7
Opossums															
Gracilinanus sp.	15	—	—	—	—	22	0.5	7	0.2	8	0.3	—	—	—	—
Lutreolina crassicaudata	445	—	—	—	—	12	7.5	—	—	—	—	—	—	—	—
Marmosini, unidentified	18	7	1.4	5	3.1	—	—	—	—	—	—	72	9.4	13	1.2
Bats															
Eumops patagonicus	13	4	0.6	46	20.6	—	—	2	0.1	2	0.1	—	—	—	—
Eumops perotis	64	—	—	—	—	1	0.1	—	—	—	—	—	—	—	—
Molossus ater	30	—	—	1	1.1	2	0.1	2	0.1	1	0.1	—	—	—	—
Molossus molossus	19	—	—	—	—	4	0.1	—	—	1	0.1	—	—	—	—
Amphibians, unidentified	8	—	—	—	—	1	0.1	10	0.1	—	—	—	—	—	—
Birds, unidentified	31	11	3.9	3	3.2	24	1.0	9	0.5	—	—	—	—	—	—
Total prey items		107		83		690		495		387		239		139	
FNB[1]		4.14		2.98		4.91		2.23		3.33		3.34		1.49	
FNBs[1]		0.45		0.22		0.26		0.10		0.19		0.39		0.10	
MGWP[2]		81.1		34.9		103		112		97.1		57.5		138	

[1] FNB = food-niche breadth and FNBs = standardized food-niche breadth; see methods.
[2]MGWP = geometric mean of weight of prey.

ples, but their proportion was negligible. Osteological remains were identified by comparison with the reference mammal collection of the Centro Nacional Patagónico, Puerto Madryn, Argentina. We followed the taxonomy in Galliari et al. (1996). For each prey type, we quantified the minimum number of individuals (MNI; determined by skull bones) and the percent biomass contribution to the diet (percent biomass = $[100\ p_i\ N_i]/\Sigma\ p_i\ N_i$, where p_i = mean prey i mass and N_i = number of individuals of the prey i). The mean prey mass were taken from literature (Redford and Eisenberg 1992) and from specimens trapped in Corrientes Province (unpubl. data). Mass of the marsh rat (*Holochilus* sp.) counted in pellets was estimated from comparisons to skeletons of this rodent of known mass collected near the study area. Large adult *Holochilus* may exceed 200 g in body mass; we used a mean mass of 150 g for this species in biomass estimations. The trophic niche breadth was measured according to the Levins index, food-niche breadth (FNB = $1/\Sigma\ p_i^2$, where p_i = proportion of each prey), and the standardized Levins index (FNBs = [FNB − minimum]/[FNB maximum − FNB minimum], where FNB minimum = 1 and FNB maximum = maximum number of prey categories [species for mammals, classes for amphibians and birds]; Marti 1987).

Results and Discussion

We identified 2262 prey items, mostly native-sigmodontine rodents (>90%). The more frequently preyed-upon species were the oryzomines *Holochilus* sp. and *Oligoryzomys* cf. *O. flavescens*. Other muroids recorded were *Akodon*

Table 1. Extended.

PASO LUCERO (8)		EA. SAN ANTONIO (9)		EA. EL ESTRIBO (10)	EA. YAGUARETÉ CORA (11)	EA. IBERÁ (12)		P.N. MBURUCUYÁ (13)	PTO. MARÍA CRISTINA (14)	
N	%B	*N*	%B	*N*	*N*	*N*	%B	*N*	*N*	%B
38	14.9	—	—	—	—	—	—	—	183	26.4
—	—	—	—	—	—	—	—	—	—	—
23	10.0	—	—	—	—	—	—	—	—	—
—	—	7	16	—	—	—	—	—	—	—
28	58.7	107	72	11	7	27	61.3	3	72	55.7
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	2	0.7	1	3	0.3
61	14.5	43	3.3	3	22	80	20.6	8	98	8.6
—	—	—	—	—	—	—	—	3	2	0.8
—	—	—	—	—	—	—	—	—	—	—
—	—	7	3.5			8	13.6	1	11	6.4
—	—	7	0.5	—	1	—	—	1	—	—
—	—	2	4.0	—	—	—	—	—	—	—
1	0.3	—	—	—	3	14	3.8	—	12	1.1
—	—	—	—	—	1	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	2	—	—	—	—	—
—	—	—	—	—		—	—	—	—	—
—	—	—	—	—	—	—	—	—	4	0.2
4	1.7	—	—	—	—	—	—	—	3	0.5
155		173		14	36	131		17	388	
3.70		2.23		—	—	2.02		—	3.10	
0.54		0.25		—	—	0.34		—	0.26	
46.2		128		—	—	45.9		—	49.9	

azarae, Calomys cf. *C. callosus, Necromys temchuki, Oxymycterus rufus,* and *Scapteromys aquaticus.* The Barn Owl also consumed variable numbers of marmosine marsupials, molossid bats, birds, and amphibians (Table 1). Although the representation of the latter groups in pellets was limited, the bat *Eumops patagonicus* was the most common prey in the Ensenadita sample. On the other hand, the marmosine marsupials were the second most frequently consumed prey in the samples from the estancias Cerro-Pytá and San Ignacio.

In terms of biomass, *Holochilus* sp. was the most important prey in the diet (31.1–87.9%), followed by *Akodon azarae, Cavia aperea,* and *Scapteromys aquaticus,* with estimates generally <15% (Table 1). The prey mass range was between 8 g (amphibians) and 445 g (*Lutreolina crassicaudata*). The geometric mean of weight of prey (GMWP) was 34.9–138.6 g. Six samples showed GMWP values >80 g (110.2 ± 21.1 g; $\bar{x}$ ± SD). For South American temperate latitudes, Marti et al. (1993) reported a GMWP of 45.1 g. Clearly, the greater values obtained for the Iberá-Ñeembucú system were related to a greater consumption of prey with mass >100 g. The high predation on *Holochilus* sp. (150 g) was unusual, because Barn Owls typically capture smaller prey (Taylor 1994) Similar results were reported by Vargas et al. (2002) in a tropical flooded savanna from northern Bolivia and by Massoia et al. (1997, 1999) for owls inhabiting the right bank of the Río Paraná in the Argentinean provinces of Chaco and Formosa. Most of the *Holochilus* sp. individuals recovered in Iberá-Ñeembucú pellets were, on the basis on tooth wear, full adult or old-adult specimens. This implied that the actual mass of these individuals was close

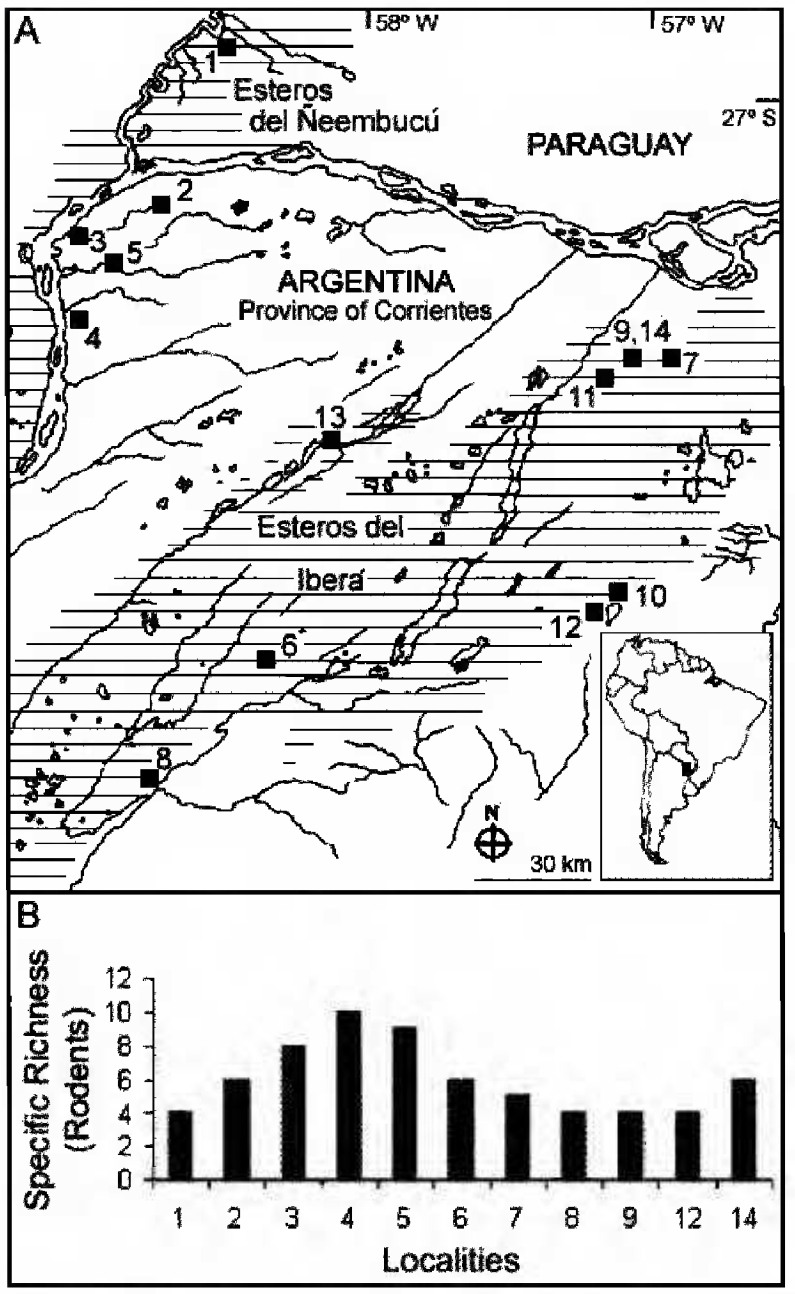

Figure 1A. Map of the study area, northeastern Argentina and southeastern Paraguay, showing the localities discussed in the text in the Ñeembucú-Iberá wetlands. 1B. Specific richness (rodents) found in pellets of Barn Owls from Iberá-Ñeembucú wetlands. Only localities with more than 50 individual prey items identified were included. Locality names for numbers are provided in Table 1.

to 200 g (Massoia 1976). On the other hand, in samples mainly composed of smaller species (e.g., *Akodon azarae, Eumops patagonicus, Oligoryzomys* spp.), the GMWP varied between 34.9–57.4 g, with a mean value (46.9 ± 8.2 g), similar to the value previously reported by Marti et al. (1993).

The FNB was 1.49–4.14 (2.79 ± 1.29; $\bar{x}$ ± SD), and the FNBs was 0.10–0.45 (0.28 ± 0.14; $\bar{x}$ ± SD). These results are similar to those previously estimated by Bellocq (2000) for the Ensenadita and Desaguadero samples (FNBs = 0.25 ± 0.04). In South America, Marti et al. (1993) reported a FNB of 4.28 (FNBs = 0.48) in temperate latitudes, and 4.61 (FNBs = 0.38) in tropical latitudes. The lower values of the Levins index for the Iberá-Ñeembucú system supports the conclusion that Barn Owls specialized on a small number of prey types.

The mean number of mammalian genera in owl pellets was 7.81 ± 2.99 ($\bar{x}$ ± SD), with a range between 4–13. In the Corrientes Province, the small mammal diversity is higher toward the confluence of the Paraná-Paraguay rivers. The recorded number of rodent species near the central part of Iberá system is clearly smaller, which is probably related to the homogeneity of the environment In fact, the participation in the assemblages of species such as *Akodon* spp., *C. callosus, N. temchuki,* and *O. rufus* increases progressively toward the periphery of the wetlands system. Trapping conducted in Iberá area showed that these rodents preferred grasslands in upland zones, while the extensive marsh areas were dominated by *Holochilus* spp. and *Oligoryzomys* spp. (Fabri et al. 2003). These general trends in rodent species richness were reflected in the Barn Owl diet (Fig. 1B). The species richness of small rodents in owl pellets for central localities from Iberá-Ñeembucú system ranged from 2–6 (N = 9 samples; $\bar{x}$ = 4.6 species). In contrast, for western marginal localities this value reached 10 (N = 4 samples, $\bar{x}$ = 8.5 species).

These contrasts, comparing central and peripheral localities, were also evident in differential predation on other groups of mammals, such as bats (Table 1). Although bats are not a common prey of the Barn Owl (Vargas et al. 2002), their frequency increased toward the northwestern study area, becoming the most abundant item in one locality (Ensenadita). Finally, in sharp contrast to what we would have predicted for a flooded and subtropical area, amphibian consumption was almost zero, despite the high diversity of this group in the Iberá system (Álvarez et al. 2002). Perhaps, most of the anurans of the Ñeembucú-Iberá system were "avoided" by owls because of their cryptic habits and small body mass (<8 g). Antipredator mechanisms in toads and frogs also include defensive postures and toxic or noxious skin secretions that may deter predation by Barn Owls. On the other hand, the high consumption of *Holochilus* in these large subtropical wetlands could be related to the fully-nocturnal habits of this amphibious rodent, its high degree of exposure during its feeding activities in open areas, and the enormous densities of this marsh rat in subtropical wetlands (Massoia 1976).

VERTEBRADOS PRESA DE *TYTO ALBA* EN HUMEDALES SUBTROPICALES DEL NORDESTE DE ARGENTINA Y ESTE DE PARAGUAY

RESUMEN.—Se estudió la dieta de *Tyto alba* en los humedales del complejo de esteros Iberá-Ñeembucú, ubicados en el nordeste de Argentina y este de Paraguay. Se identificaron 2262 presas, con una neta predominancia de roedores sigmodontinos nativos (>90%). *Holochilus* sp. y *Oligoryzomys* cf. *O. flavescens* fueron las especies mejor representadas. La media geométrica del peso de las presas

consumidas asumió valores entre 34.9–138.6 g y la amplitud de nicho trófico fluctuó entre 1.5–4.1. Es destacable el importante consumo de presas con un peso >100 g, que se refleja en una media geométrica del peso de las presas >80 g. Igualmente destacables son los bajos valores de riqueza de roedores que se observan en aquellas localidades centrales al sistema de humedales (entre 2–6 especies), en contraste con los observados en localidades periféricas del oeste (entre 6–11). En estos ambientes inundables subtropicales, la dieta de *T. alba* se focaliza básicamente en el consumo de *Holochilus* sp., un roedor anfibio netamente nocturno que alcanza grandes densidades poblacionales.

[Traducción de los autores]

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